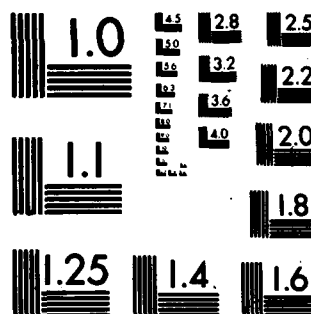


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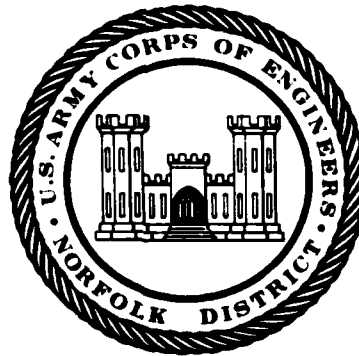
Name Of Dam: WESTVACO NO.2 FLYASH LAGOON

Location: ALLEGHENY COUNTY

Inventory Number: VA. 00504

LEVEL II

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM



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PREPARED BY
NORFOLK DISTRICT CORPS OF ENGINEERS
803 FRONT STREET
NORFOLK, VIRGINIA 23510

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER VA 00504	2. GOVT ACCESSION NO. AD AC91439	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Phase I Inspection Report National Dam Safety Program Westvaco No. 2 Flyash Lagoon Allegheny County		5. TYPE OF REPORT & PERIOD COVERED Final
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Norfolk District Corps of Engineers 803 Front Street Norfolk, Virginia 23510		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS U. S. Army Engineering District. Norfolk 803 Front Street Norfolk, Virginia 23510		12. REPORT DATE July 1980
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		13. NUMBER OF PAGES
		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES Copies are obtainable from National Technical Information Service, Springfield, Virginia 22151		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Dams - VA National Dam Safety Program Phase I Dam Safety Dam Inspection		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) (See reverse side)		

20. Abstract

Pursuant to Public Law 92-367, Phase I Inspection Reports are prepared under guidance contained in the recommended guidelines for safety inspection of dams, published by the Office of Chief of Engineers, Washington, D. C. 20314. The purpose of a ~~Phase I~~ investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general conditions of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

Based upon the field conditions at the time of the field inspection and all available engineering data, the ~~Phase I~~ report addresses the hydraulic, hydrologic, geologic, geotechnic, and structural aspects of the dam. The engineering techniques employed give a reasonably accurate assessment of the conditions of the dam. It should be realized that certain engineering aspects cannot be fully analyzed during a Phase I inspection. Assessment and remedial measures in the report include the requirements of additional indepth study when necessary.

~~Phase I~~ ^{This} report includes project information of the dam and appurtenances, all existing engineering data, operational procedures, hydraulic/hydrologic data of the watershed, dam stability, visual inspection report and an assessment including required remedial measures.

JAMES RIVER BASIN

NAME OF DAM: WESTVACO #2 FLYASH LAGOON
LOCATION: ALLEGHANY COUNTY, VIRGINIA
INVENTORY NUMBER: VA 00504

**PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM**

*2. Flyash Lagoon (Concrete Dam)
Number: VA-00504, Town: F...
Alleghany County, VA, ...
James River.*

9/1/81

10/5/81

**PREPARED BY
NORFOLK DISTRICT CORPS OF ENGINEERS
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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of the Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (flood discharges that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the design flood should not be interpreted as necessarily posing a highly inadequate condition. The design flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

BRIEF ASSESSMENT OF DAM

Name of Dam: Westvaco #2 Flyash Lagoon
State: Virginia
Location: Alleghany County
USGS Quad Sheet: Callaghan
Stream: Hollow off Dunlap Creek
Date of Inspection: 28 May 1980

The Westvaco #2 Flyash Lagoon Dam is an earthfill structure 650 feet long and 184 feet high. The dam is owned and maintained by Westvaco Corporation. The dam is classified as a large dam with a significant hazard classification. The principal spillway was a concrete drop-inlet located in the center of the reservoir. This conduit has been plugged at the inlet invert and a new structure provided just upstream of the dam on the left abutment. A decant pipe line, from this new concrete drop-inlet, is used to pass water into the Jackson River. An open channel emergency spillway is located in natural rock to the right of the right abutment. The flyash storage reservoir is approaching the maximum design storage volume. At the present time, the flyash storage reservoir is inactive.

Based on criteria established by the Department of the Army, Office of the Chief of Engineers (OCE), the Spillway Design Flood (SDF) is the PMF. The spillways will pass the SDF without overtopping the dam. The spillways are adjudged as adequate.

The visual inspection revealed no findings that proved the dam to be unsound. However, it is recommended that the services of a qualified geotechnical engineering firm be engaged to perform a stability check of the dam. This should be completed within 12 months. An emergency warning system should be established and the maintenance items listed in Section 7.2 be accomplished as part of a regular maintenance program within the next 12 months.

Submitted By:
Original signed by
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JAMES A. WALSH, P. E.
Chief, Design Branch

Recommended By:
Original signed by
JACK G. STARR
JACK G. STARR
Chief, Engineering Division

Approved:
Original signed by:
Douglas L. Haller
DOUGLAS L. HALLER
Colonel Corps of Engineers
District Engineer

Date: AUG 27 1980



CREST



DOWNSTREAM FACE

OVERALL VIEWS
NO.2 FLYASH LAGOON DAM

28 MAY 1980

SECTION 1

PROJECT INFORMATION

1.1 GENERAL:

1.1.1 Authority: Public Law 92-367, 8 August 1972, authorized the Secretary of the Army, through the Corps of Engineers to initiate a national program of safety inspections of dams throughout the United States. The Norfolk District has been assigned the responsibility of supervising the inspection of dams in the Commonwealth of Virginia.

1.1.2 Purpose of Inspection: The purpose is to conduct a Phase I inspection according to the Recommended Guidelines for Safety Inspection of Dams (Reference 1, Appendix IV). The main responsibility is to expeditiously identify those dams which may be a potential hazard to human life or property.

1.2 Project Description:

1.2.1 Dam and Appurtenances: Westvaco #2 Flyash Lagoon Dam is an earthfill embankment dam 650 feet long and 184 feet high. The crest of the dam is 36 feet wide with a crest elevation of 1440.0. A service road traverses the entire crest length. The upstream slope is 2 horizontal to 1 vertical (2:1) up to elevation 1375.0, (1.88:1) to elevation 1425 and approximately (1.5:1) to the crest. The downstream slope is 1.97:1 based on a 1977 survey.

It is reported that the core was placed in a cutoff trench to sound shale. There are no known drains other than the principal outfall pipe.

The principal spillway is a 5.5 foot square concrete drop-inlet with crest elevation of 1425.0 feet msl located in the center of the reservoir. A 16-inch cast iron pipe runs through the dam with invert at elevation 1301.0 and discharged into the mill waste treatment plant. A wooden walkway supported by oil drums allows access to the drop-inlet from the center of the embankment. This pipe has been reportedly blocked with a cypress plug on the intake end.

A 14-inch decant pipe connected to a concrete drop-inlet, with a crest elevation of 1416.25, upstream of the left abutment allows flow from the reservoir to be discharged into the Jackson River. Stop logs have been placed in the drop-inlet raising the pool to approximately elevation 1423. A floating boom prevents debris from entering the drop-inlet.

Two new flyash clarifiers (lagoons) have been constructed above the left abutment. Decant water is passed from the clarifiers via a decant pipe to the drop inlet at the left abutment where it flows into the Jackson River.

An open channel emergency spillway is cut into natural rock, right of the right abutment. The spillway crest is at elevation 1436.0 and is 30 feet wide with near vertical slopes.

1.2.2 Location: Westvaco #2 Flyash Lagoon Dam is located in a small hollow north of Dunlap Creek and just west of Covington, Virginia.

1.2.3 Size Classification: The dam is classified as a large size structure based on the height (184 feet).

1.2.4 Hazard Classification: The dam is located upstream of 2 main lines of the Chesapeake and Ohio Railroad. If a dam failure were to occur, the railroad and possibly industries along Dunlap Creek to Jackson River could encounter large economic losses; therefore, a significant hazard classification is given for this structure according to guidelines contained in Section 2.1.2 of Reference 1, Appendix IV. The hazard classification used to categorize dams is a function of location only and has nothing to do with their stability or probability of failure.

1.2.5 Ownership: Westvaco Corporation

1.2.6 Purpose: Flyash Lagoon.

1.2.7 Design and Construction History: The original dam was designed by either Westvaco engineers and checked by Muesser, Rutledge, Wentworth & Johnson (MRWJ) or designed by MRWJ after Westvaco developed the conceptual plan. The records are not clear on this item. The dam was constructed by Plecker Brothers in 1966. The dam was raised 30 feet in 1968 by Plecker Brothers, 20 feet in 1972 by F. Clayton Plecker & Sons, and 15 feet in 1977 by Hammond & Mitchell, who subcontracted the earthwork to F. Clayton Plecker. The dam has reached its maximum design storage; therefore, the use for flyash storage has been stopped. In 1974, the core of the dam was grouted to stop seepage occurring at the toe. The contractor was Cunningham Core Drilling & Grouting Corp., Salem, Virginia, and the owner indicated that the grouting was successful. The structure will remain at its present height but serve no specific function.

1.2.8 Normal Operational Procedures: Water is passed from the two flyash lagoons above the left abutment and from local flow into the reservoir through a 14-inch decant pipe running down the left abutment and through the Westvaco property to discharge into the Jackson River. The flyash has settled in the reservoir with the outer perimeter elevations 10-12 feet higher than at the decant drop-inlet.

1.3 Pertinent Data:

1.3.1 Drainage Area: The dam controls a drainage area of 0.06 square miles.

1.3.2 Discharge at Dam Site: Maximum flood - This occurred in June of 1972 during the remnants of Hurricane Agnes. During this storm, the reservoir rose approximately 3 inches.

Pool level at top of dam

Emergency Spillway 720 cfs

1.3.3 Dam and Reservoir Data: Pertinent data on the dam and reservoir are shown in the following table:

TABLE 1.1 DAM AND RESERVOIR DATA

Item	Elevation feet msl	Reservoir			
		Area, acres	Capacity		Length feet
			Acre, feet	Watershed, inches 1/	
Top Dam	1440	22	1496	467.5	1150
Emergency Spillway Crest	1436	21.2	1410	440.7	1100
Principal Spillway Crest	1425	19.3	1200	375.0	1000
Downstream toe of Dam	1256	--	--	--	--

1/Flyash in the reservoir contributes 375 watershed inches.

*The new drop-inlet (elevation 1416.25) has been raised to about elevation 1423 by stop logs. The flyash slopes to elevation 1429 at the principal spillway and about 1430 around the perimeter of the reservoir.

SECTION 2

ENGINEERING DATA

2.1 Design: Reports and records of design were limited to the following:

(a) letter from Muesser Rutledge Wentworth and Johnston (MRWJ) to Westvaco, 16 August 1965, subject: New Fly Ash Lagoon Dam.

(b) Drawings C-65-429-O-K, 4 Dec 67 site plan and details for Phase 2 Construction to elevation 1405 msl and Drawing C-65-434-2 for 65 foot extension on concrete drop-inlet.

(c) Drawings C-76-405-1, site plan; C-76-406-1, embankment section for Phase 3 Construction.

(d) New standpipe Drawings C-77-126-1 and C-77-160-1 for Phase 4 Construction.

(e) Westvaco memo 6 Jul 77, subject, dye test in flyash standpipe.

The above design information was furnished by Mr. W. D. Majors and Mr. Mark Campbell, Westvaco. Prior to the field inspection, the team met to discuss and review the design and construction documents. From this discussion, it is believed that Westvaco developed the conceptual plan for the embankment and released it to an engineering firm for design. Reference (a) above includes a statement referring to "our report of October 20, 1964", which indicates that MRWJ may have been the designer for the embankment or at least had some input. The records are not clear on this point. Essentially, the design called for an inclined clay core, 36-foot at the base and 8-foot at the top, flanked on each side by compacted shale grading from the fine and most weathered materials adjacent to the core and the largest and least weathered fragments placed in the outer sections of the upstream and downstream faces. A cut-off trench excavated to relatively sound shale covered by a "slush grout" was also recommended. The design recommendations in reference (a) called for cleaning and stripping of the foundation area and recommended 1 vertical on 2 horizontal side slopes. The design was based on a two phase construction and instructions for second phase construction were outlined. No records of any stability studies or other design calculations were available. Review of the geology of the Appalachian Valley in Virginia by Charles W. Butts indicates the dam site is underlain by the Brallier shale of Devonian age. The Brallier is described as a rather monotonous mass of subfossils, stiff, more or less sandy and micaceous green shale with interbedded layers of fine ground sandstone.

2.2 Construction: Reports and records of construction were furnished by Westvaco and included:

(a) Specifications for the Phase 4 Construction dated 12 Oct 76.

(b) Reports of moisture-density determinations and daily inspection reports of controlled fill for the Phase 3 and 4 Construction, dated Sep 72 and Apr 77.

(c) A few photos of construction were made available for review by the inspection team.

The existing 184-foot high dam was constructed in four phases. The initial 119-foot placement was completed in Aug 66 by Plecker Brothers Construction Co. It was reported that the core trench had been excavated to sound shale and slush grouted before placement of the clay. The slush grout was allowed to dry before clay placement. No field density tests were reported in the core zone for this phase of construction. A 5.5-foot square concrete drop-inlet, to elevation 1365, and 16-inch diameter cast iron drain pipe, placed under the dam to drain water from the flyash disposal slurry, were also constructed. Westvaco did not believe that seepage collars had been used on this drain. Upstream and downstream slopes were constructed at 1 vertical to 2 horizontal based on the section shown on drawing C-76-406-1, reference 2.1(c) above.

The Phase 2 Construction, completed in Sep 68 by Plecker Brothers Construction Co. raised the dam to elevation 1405 msl, an additional 30 feet. No construction records are available for this construction; however, it was reported that the top foot of the clay core was removed and the exposed surface reworked before placing new core material. Pictures indicate that a double-drum sheepsfoot roller was on site. No information was available on the compaction equipment for the ripped shale placed on each face or the method of interfacing the new rock fill with the old fill. Again, the core trench was reported to be founded on sound shale and slush grouting was performed and allowed to dry before placing core.

Phase 3 Construction to elevation 1425 msl, an additional 20 feet, was completed in Dec 72 by F. Clayton Plecker Construction Co. The only records available for this phase of construction are a series of 65 field density tests and 1 moisture density determination. No other information was available on compaction of the rock or interfacing the old and new fill. It was reported that the core trench had been carried to sound shale, slush grouted and clay material placed with the grout still wet.

The Phase 4 Construction, completing the dam to elevation 1440, or 184-foot high and construction of a new principal outlet in the left abutment was finished in June 77 by Hammond and Mitchell Inc. The earthwork portions were subcontracted to F. Clayton Plecker. The only records of construction are two moisture density determinations and 25 field density tests. The first report indicates that the top one foot of the previously placed core was removed and the surface reworked before placing new fill. The reports indicate equipment included 1 dozer with sheepsfoot. The size and type of sheepsfoot was not documented.

2.3 Modifications: In June 74, reported clear leakage at the toe of the phase 3 construction was observed and an exploration and grouting remedial action was accomplished by drilling holes into the core. No records or reports on the operation were available; however, a leak at the toe was observed at the inspection on 28 May 80 and is covered in Section 3. In Jun 77, reference 2.1(e) indicates the principal spillway was dye tested and within 7 minutes dye showed up in a leak near the phase 4 toe and right abutment contact. The dye cleared up 22 minutes after the feed ceased. The very small leak at the left abutment toe contact did not show any traces of dye. This small left abutment leak was not discernible at the May 80 inspection. It was reported that a cypress plug was forced into the old 16-inch diameter drain pipe when the new principal spillway was constructed in 1977, however the right abutment toe leak is still present. No records of the 1974 leakage quantities were provided.

2.4 Evaluation: The lack of design data and the questionable results of some of the construction data furnished provide insufficient information to evaluate the foundation condition and embankment stability. Review of the 1972 field density reports and comparison to the reported maximum density-optimum moisture indicates the possibilities exist of variations in material properties or possible errors in calculations. The maximum density was 89.6 pcf at an optimum moisture of 29.1%. The average field density and placement moisture contents for the 65 tests are 91.9 pcf and 20.6%, respectively. The high-low values of maximum density and optimum moisture are 97.9 and 83.8 pcf, respectively, and 28.7 and 14.3%, respectively. Examination of the 1977 maximum density-optimum moisture, zero air voids curve data and field density-moisture data indicate the control data to be questionable. Both moisture density determinations indicate maximum density-optimum moisture at about 100 percent saturation based on the reported specific gravity. About 75 percent of the field density tests indicate densities at moisture contents greatly exceeding 100 percent saturation for an average soil specific gravity of about 2.65 to 2.7.

SECTION 3
VISUAL INSPECTION

3.1 Findings:

3.1.1 General: The observations from the 28 May 80 inspection are recorded in Appendix III. Return visits have been limited to Westvaco personnel to record seepage flow and temperature at the right abutment seep. The weather was clear and sunny, 72° F. temperature, and the ground conditions were dry. Pool elevation of flyash waste varied between 1423 to 1430 msl, which is the design elevation. No tailwater was observed. There are no known prior written inspection reports.

3.1.2 Embankment: Visually, the embankment appears in good condition. There are no signs of surface cracks, misalignment, sloughing, or unusual movement. Surface erosion gullies are present at the left abutment-embankment catch line and to a much less extent on the right abutment. Some rutting from vehicular traffic is evident on the crest. There are slight concave depressions in the downstream slope.

There is an area of seepage at the toe of the dam near the right abutment. Also, a boil exists about 15 feet downstream from the toe. Seep temperature was not recorded on 28 May 80. Visual observations indicated most of the seepage and boil runoff was channeled through a culvert under the railroad. No surface sources feeding this culvert were observed. Measured flow at the culvert outfall was 41 gpm. Following request from the inspection team, Westvaco personnel observed the seepage and reported the following flows at the culvert:

30 May	63°F. temperature at toe of dam
	61°F. temperature at boil
9 Jun 80	16.5 gpm flow at culvert
	63°F. temperature
16 Jun 80	13 gpm flow at culvert
	63.5°F. temperature
23 Jun 80	10.5 gpm flow at culvert
	63.5°F. temperature
9 Jul 80	6 gpm flow at culvert
	63.5°-64° temperature
4 Aug 80	No flow observed

The seepage and boil are shown on photograph number 6. Flow appeared to be clear except after disturbance of the boil. After a few minutes, this would clear. There are some small trees on the downstream slope. There are no known drains other than those transferring waste water to the Jackson River.

3.1.3 Outlet Works: A 16-inch cast iron pipe running from a drop-inlet in the reservoir is reported to be plugged at the intake end. A wooden walkway supported by oil drums allows access to the drop-inlet. A drop-inlet near the left abutment appears to be in good condition. A 14-inch decant pipe, connected to the drop-inlet at low level, allows water to discharge into the Jackson River.

3.1.4 Emergency Spillway: The control section is a 30-feet wide open channel cut into natural rock and located to the right of the right abutment. The discharge channel is steep with trees and shrubs on the slope. Flows would discharge into Dunlap Creek.

3.1.5 Reservoir: The reservoir slopes are naturally steep and for the most part weathered shale. The reservoir consumes most of the drainage area. Flyash waste has completely filled the design maximum storage volume. The flyash elevation varies from about elevation 1430 at the perimeter of the reservoir to about 1423 at the drop-inlet near the left abutment.

3.1.6 Downstream Channel: There is no downstream channel. The area below the dam contains 2 C&O Railroad main tracks, which are about 50 feet from Dunlap Creek. A few industrial buildings are located just downstream on Dunlap Creek.

3.1.7 Instrumentation: There is no known instrumentation in or around the dam.

3.2 Evaluation: Overall, the embankment appeared in good condition at the time of the inspection. The inspection did reveal certain items that should be incorporated as part of a preventative maintenance program;

a. Remove the small trees from the downstream slope and those which may appear in the future.

b. Grade and crown access road on crest to improve drainage and reduce rutting.

c. Grade haul roads on left abutment to route surface runoff away from the embankment and fill existing erosion gullies with compacted shale fragments.

d. Monitor seepage and boils, particularly observing for increase in flow quantity and piping of materials.

e. Monitor embankment monthly for surface cracking or unusual movement indicative of internal stress.

SECTION 4

OPERATIONAL PROCEDURES

4.1 Procedures: The placement of flyash into the reservoir has been concluded since the reservoir has reached its maximum design storage volume. The level of flyash varies 3-4 feet in the reservoir with the pool sloping from perimeter to the decant drop-inlet. Rainfall and runoff may continue to fall into the reservoir and flow into the drop-inlet at elevation 1423, and discharge into a decant pipe at elevation 1416.9, before passing into the Jackson River. The principal spillway inlet is blocked with a cypress plug at the intake end. If the reservoir reaches elevation 1436.0, the emergency spillway will pass flows into Dunlap Creek.

4.2 Maintenance: There is no regular maintenance program performed by Westvaco Corporation; however, the dam is visited weekly for visual inspection by Westvaco personnel.

4.3 Warning System: At present time, there is no warning system or evacuation plan for Westvaco #2 Flyash Lagoon Dam.

4.4 Evaluation: The dam does not require an elaborate operational and maintenance procedure. A maintenance program should be established to detect and correct any deficiencies as they occur. An emergency operation and warning plan should be developed. It is recommended that a formal emergency procedure be prepared and furnished to all operating personnel. This should include:

- a. How to operate the dam during an emergency.
- b. Who to notify, including public officials, in case evacuation from the downstream area is necessary.

SECTION 5

HYDRAULIC/HYDROLOGIC DATA

5.1 Design: None were available.

5.2 Hydrologic Records: None were available.

5.3 Flood Experience: The worst flood of record was caused by the remnants of Hurricane Agnes in June 1972 when the reservoir rose approximately 3 inches.

5.4 Flood Potential: The 1/2 PMF and PMF inflow volumes were developed for the reservoir. The rainfall applied to the developed storage volume was obtained from the U. S. Weather Bureau Publication (Reference 3, Appendix IV). Flow through the decant pipe was neglected.

5.5 Reservoir Regulation: Pertinent dam and reservoir data are shown in Table 1.1.

Water passes automatically through the drop-inlet into the decant pipe leading to Jackson River. Water will pass automatically through the emergency spillway when the reservoir rises above elevation 1436.0.

The storage curve was developed based on areas obtained from a U. S. Geological Survey Quadrangle Map. A rating curve was developed for the emergency spillway. In routing hydrographs through the reservoir, it was assumed that the initial pool level was at elevation 1427.5, which was the average elevation of flyash in the reservoir at the time of the inspection.

5.6 Overtopping Potential: The predicted rise in the reservoir and other pertinent data were determined by storing the volume of inflow in the reservoir without any discharge. The results for the flood conditions (PMF, 1/2PMF) are shown in the following Table 5.1:

Table 5.1 RESERVOIR PERFORMANCE

Item	Normal Flow	1/2 PMF	PMF 1/
Total Inflow, Ac-Ft	-	54.9	109.8
Maximum Storage	1250	1304.9	1359.8
Maximum Pool Elevation Ft. msl	1427.5	1431	1433.5

1/ The PMF is an estimate of flood discharges that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region.

5.7 Reservoir Emptying Potential: The reservoir cannot be emptied except through seepage or pumping. Flyash has filled the reservoir from elevation 1423.0 to 1430; therefore, any water ponding in the reservoir will drop into the drop-inlet and pass through the decant pipe to the Jackson River.

5.8 Evaluation: Based on the size (large) and hazard classification (significant) the recommended Spillway Design Flood (SDF) is the PMF. The reservoir will store 100 percent of the PMF without any discharge.

Conclusions pertain to present day conditions. The effect of future development on the hydrology has not been considered.

SECTION 6

DAM STABILITY

6.1 Foundation and Abutments: There is no information available on the foundation conditions at the site. The dam is located over the Brallier shale in the Valley and Ridge geologic region of Virginia. This formation is considered competent to support the dam if adverse jointing and weak bedding features are not present. Construction instructions indicated that "the foundation and abutment areas should be cleared of all vegetation and stripped of all soil materials and the highly weathered portion of the shale. Except for the cut-off trench at the clay core contact, heavily fractured shale, which consists of hard, intact pieces, will form a satisfactory foundation for the dam. At the contact of this clay core with the foundations and abutments, a cut-off trench should be excavated to relatively sound shale." There was no information pertaining to the soundness of the exposed shale foundation for the core or rock shells. There are no known foundation drainage systems.

6.2 Embankments:

6.2.1 Materials: Information on the embankment material quality and nature is very limited. Phase 3 & 4 quality control records indicate the clay core was obtained from a borrow pit behind the Covington Boys Home and borrow areas on the left and right abutments, respectively. Atterberg limit data for Phase 4 indicate the material classifies as an (ML) by the Unified Soil Classification System. Liquid and plastic limits were 43 & 29 and 39 & 29 for two tests. Information on the rolled shale material, other than a verbal report that it came from borrow areas contiguous to the reservoir, is not available. Other than written instruction to place the finer, more weathered material contiguous to the core, there appear to be no filter layers or drainage blankets used.

6.2.2 Stability: There are no available stability studies or calculations. The dam is 184 feet high and the crest is about 36 feet wide. The downstream slope averages slightly less than 1 vertical to 2 horizontal based on a 1977 survey. The visible portion of the upstream face is steep, estimated to be about 1 vertical to 1.5 horizontal. Plans indicate the upstream face to be about 1 vertical to 2 horizontal to elevation 1375 msl or 119 feet, 1 vertical to 1.88 horizontal for the next fifty feet, and 1 vertical to 1.5 horizontal for the last 15-foot phase of construction. The embankment is not subject to drawdown except the slow draining of a 6+-foot deep pool

which would accumulate during the PMF. Since the embankment is not subject to rapid drawdown, the approximate 1 vertical to 2 horizontal slopes are considered adequate. There were no visual observations of unusual movement or cracking to indicate any internal distress.

6.2.3 Seismic Stability: The dam is located in Seismic zone 2. Therefore, according to the Recommended Guidelines for Safety Inspection of Dams, the dam is considered to have no hazard from earthquakes, provided the static stability conditions are satisfactory and conventional safety margins exist.

6.3 Evaluation: There is insufficient information to adequately evaluate the stability of the embankment or the foundation. Because of the potential for economic losses to the public through possible disruption of the mainline C&O tracks and downstream industries, the lack of stability design data, questionable quality control records and the lack of information of interfacing the 4 phases of construction, it is recommended that the service of a qualified geotechnical engineering firm be engaged to perform a stability check of the dam. This should be completed within 12 months. In the interim, monthly monitoring for surface cracking with unusual movements should be accomplished.

SECTION 7

ASSESSMENT/REMEDIAL MEASURES

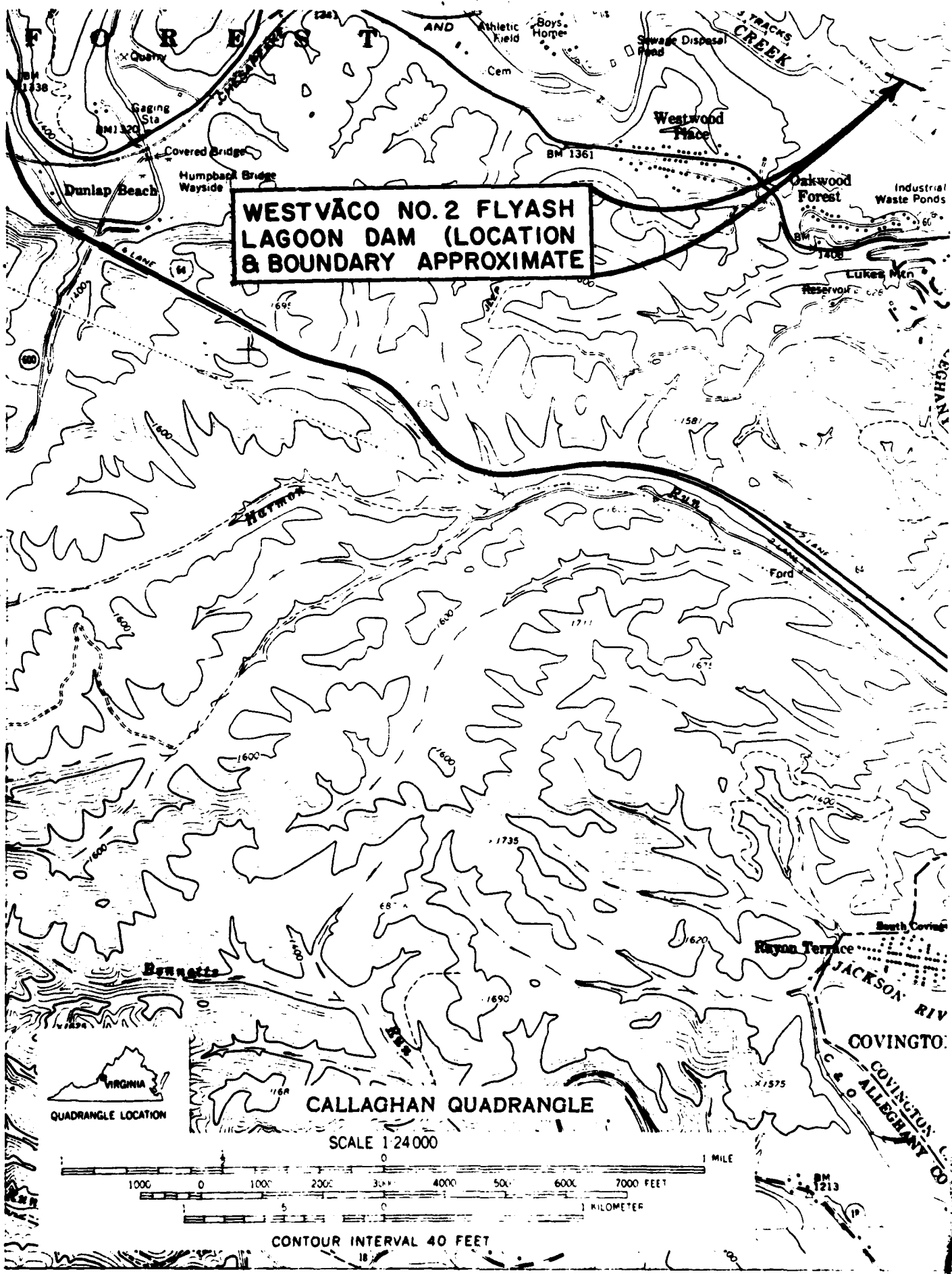
7.1 Dam Assessment: The available engineering data is insufficient to adequately evaluate the stability of the embankment or the foundation. The visual inspection revealed no findings that proved the dam to be unsound. There is no maintenance or inspection program and no emergency operation and warning plan. Overall, the dam is in fair condition. Corps guidelines indicate the appropriate Spillway Design Flood (SDF) for a large size and significant hazard dam is the PMF. The PMF can be contained in the reservoir without passing any flows; therefore, the spillways are considered adequate.

7.2 Recommended Remedial Measures: It is recommended that the services of a qualified geotechnical engineering firm be engaged to perform a stability check of the dam. This should be completed within 12 months. A regular maintenance and inspection program should be initiated to help detect and control problems as they occur. A formal emergency procedure should be prepared, including how to operate the dam in an emergency and who to notify, including public officials, in case evacuation from the downstream area is necessary. Also, the inspection revealed the following maintenance items that should be scheduled by the owner during a regular maintenance period within the next 12 months:

- a. Remove the small trees from the downstream slope and those which may appear in the future.
- b. Grade and crown access road on crest to improve drainage and reduce rutting.
- c. Grade haul roads on left abutment to route surface runoff away from the embankment and fill existing erosion gullies with compacted shale fragments.
- d. Monitor seepage and boils, particularly observing for increase in flow quantity and piping of materials.
- e. Monitor embankment monthly for surface cracking or unusual movement indicative of internal stress.

APPENDIX I

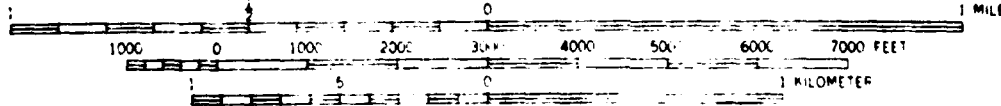
MAPS AND DRAWINGS



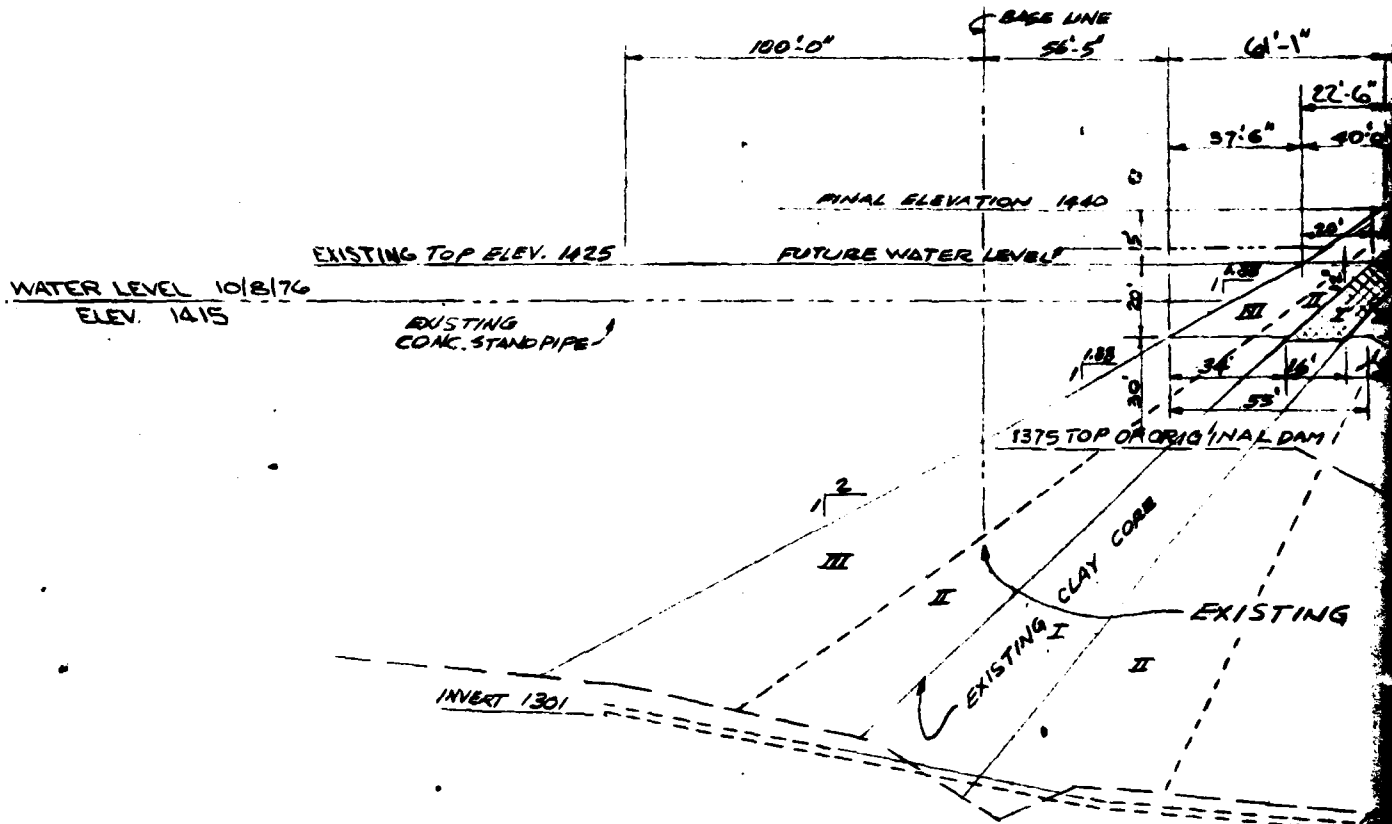
**WESTVACO NO. 2 FLYASH
LAGOON DAM (LOCATION
& BOUNDARY APPROXIMATE)**

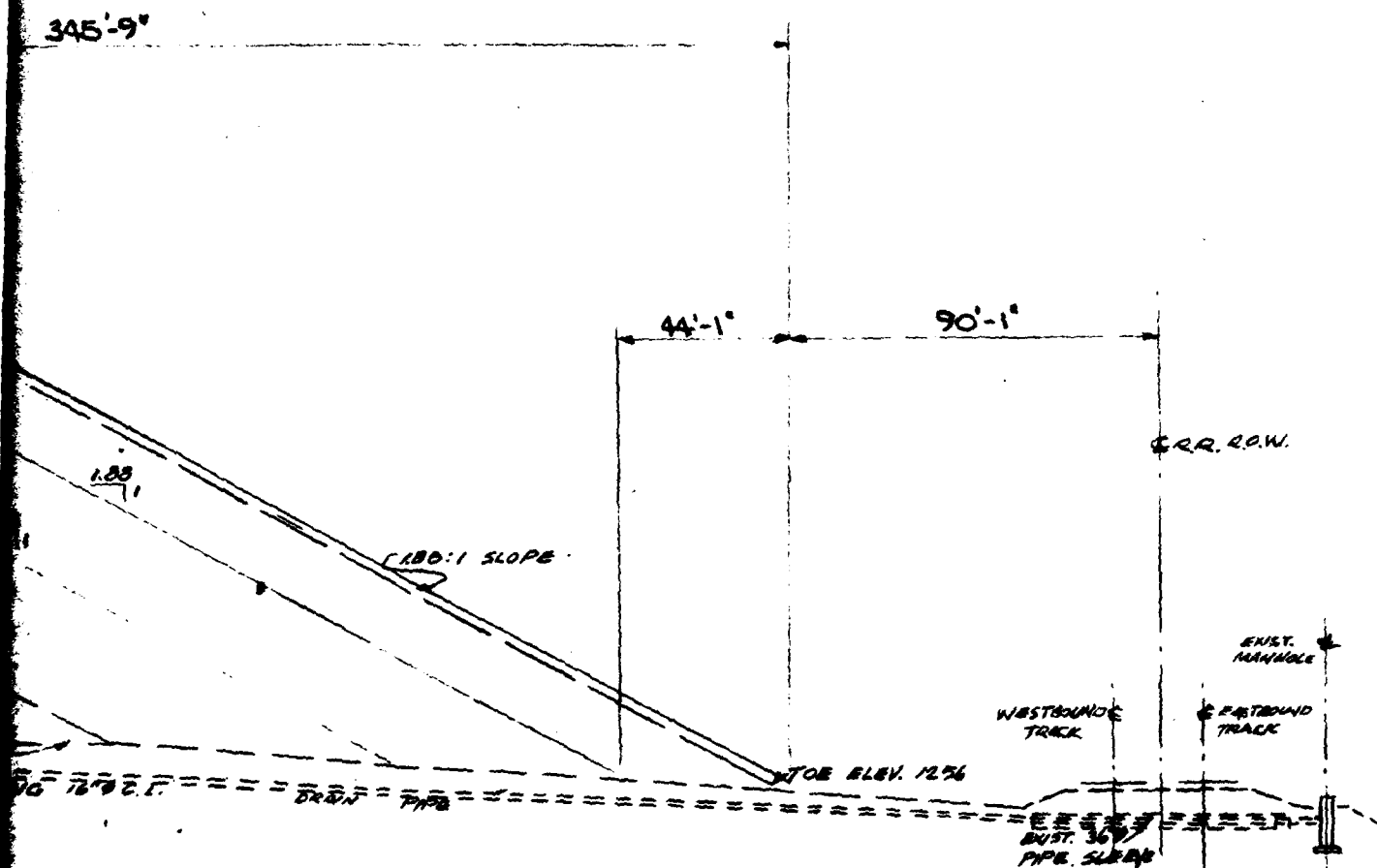
CALLAGHAN QUADRANGLE

SCALE 1:24,000



CONTOUR INTERVAL 40 FEET





CORPS OF ENGINEER REPRODUCTION
IN PART OF WESTVACO
DRAWING NO. C-76-406-1
DATED 10-13-76 TITLED:

ENLARGE CAPACITY OF
FLYASH DAM - 1977
SECTION
PLATE I

15

PLATE II D-357

1. 100' contour line
 2. 200' contour line
 3. 300' contour line
 4. 400' contour line
 5. 500' contour line
 6. 600' contour line
 7. 700' contour line
 8. 800' contour line
 9. 900' contour line
 10. 1000' contour line
 11. 1100' contour line
 12. 1200' contour line
 13. 1300' contour line
 14. 1400' contour line
 15. 1500' contour line
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 17. 1700' contour line
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 19. 1900' contour line
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 97. 9700' contour line
 98. 9800' contour line
 99. 9900' contour line
 100. 10000' contour line

ADDITIONAL INFORMATION
 EVALUATION CAPACITY OF
 PLANT 1000 1977
 DATE PLANT

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APPENDIX 11

PHOTOGRAPHS



PHOTO *1 DOWNSTREAM FACE

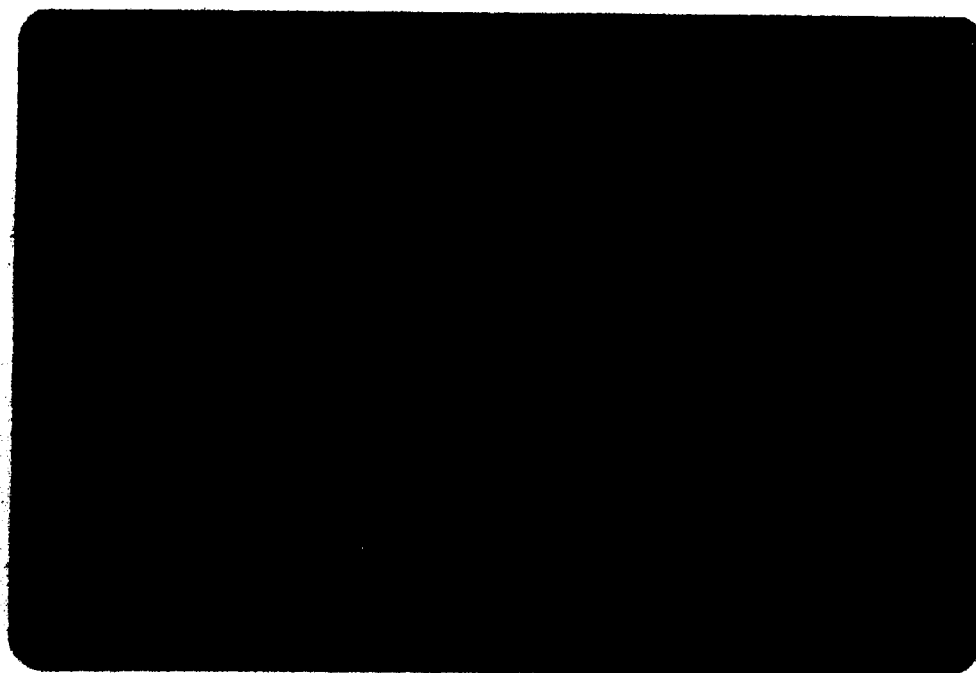
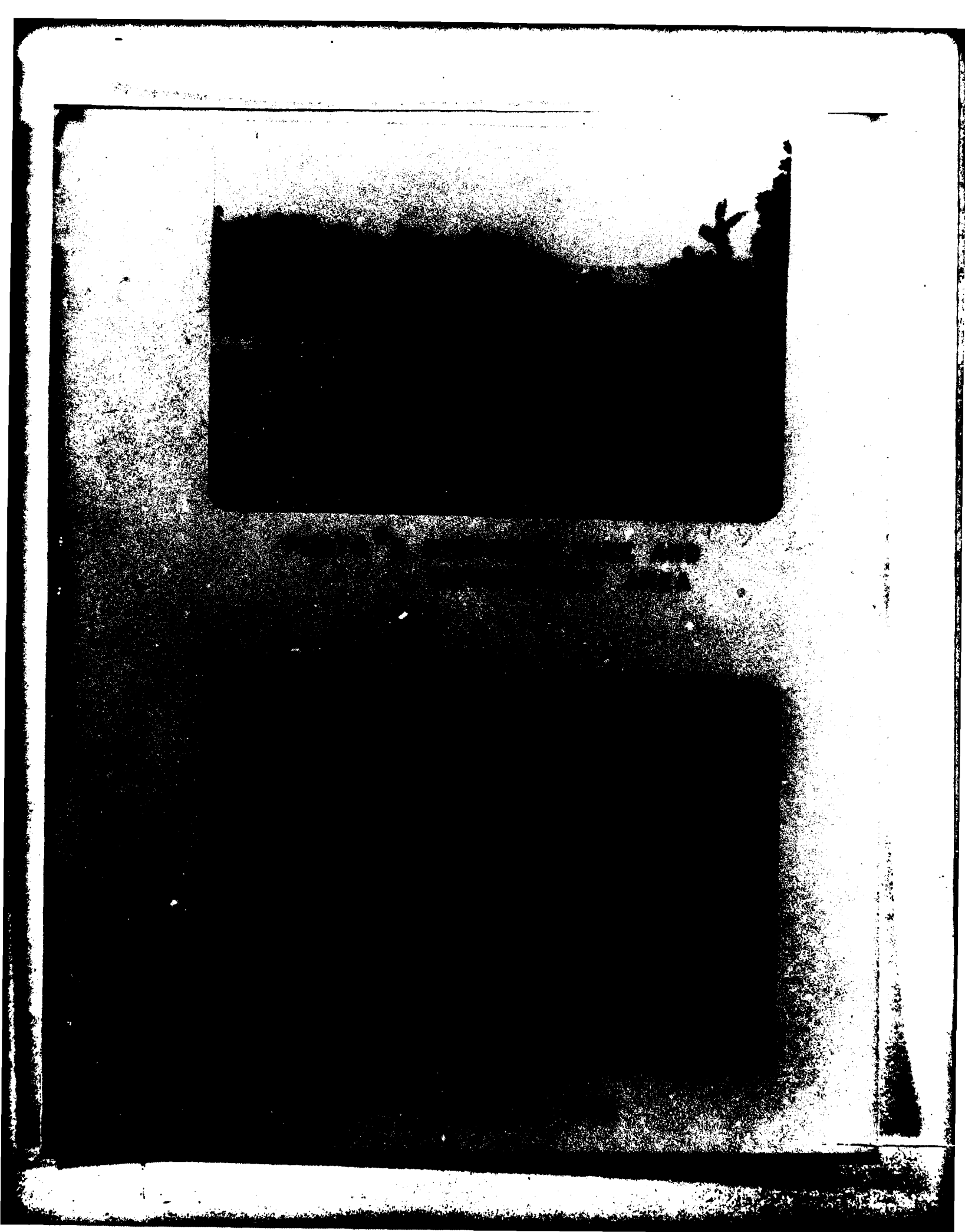


PHOTO *2 UPSTREAM FACE





**PHOTO 5 EROSION ADJACENT TO CONTACT
OF LT. ABUTMENT AND EMBANKMENT**

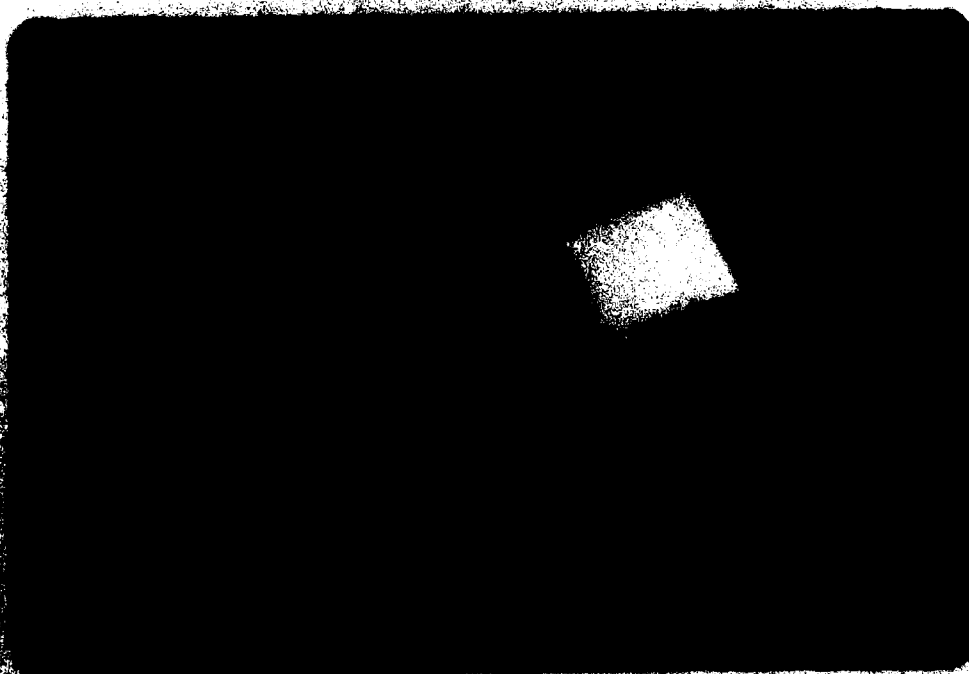
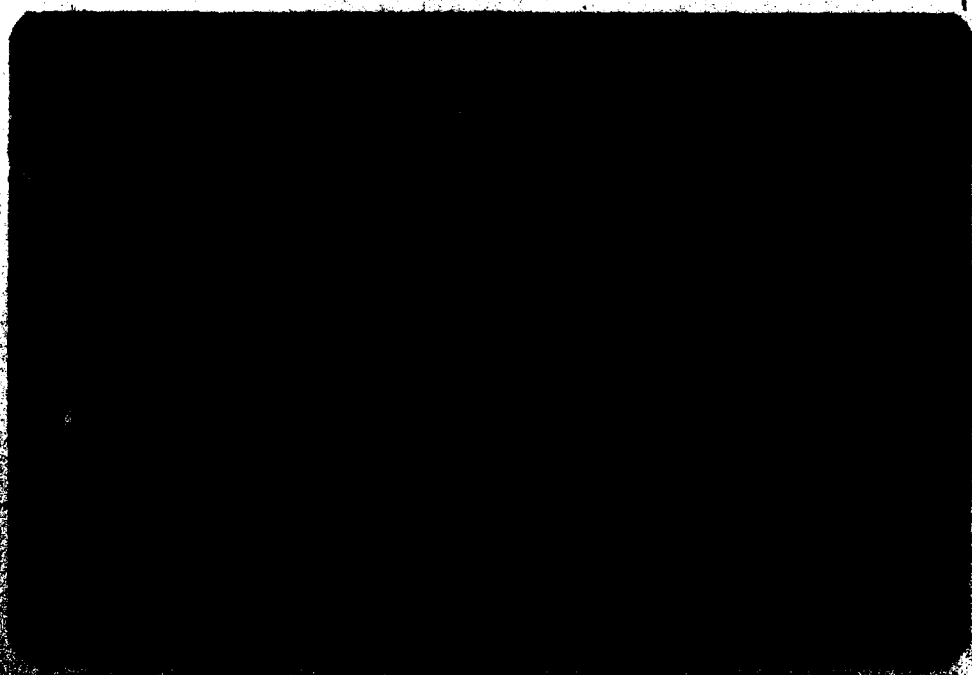


PHOTO 6 "BOIL" AT TOE OF DAM



APPENDIX III
FIELD OBSERVATIONS

Check list
Visual Inspection
Phase I

Name Dam: Westvaco #2 County: Alleghany State: VA Coordinates: Lat 37° 48.3' Long 80° 00.2'
Flyash Lagoon Dam

Date Inspection: 28 May 80 Weather: Clear Temperature: 72°F

Pool Elevation at Time of Inspection: 1427.5 ± MSL Tailwater at Time of Inspection: NA

Inspection Personnel:

William Major WVCO
Mark Campbell, WVCO

Dave Bushman, SWCB Carl Anderson, COE
Leon Musselwhite, SWCB Jim Robinson, COE
Hugh Gildea, SWCB Bo Taran, COE

Robinson Recorder

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	No surface cracks were observed, however, considerable shallow rutting in earth roadway across crest.	Unless rutting progresses, no immediate concern. Recommend grading road and crowning to increase runoff.
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	No unusual movement or cracking observed at or beyond toe.	Periodically check for unusual movement or cracking.
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Deep 1' to 2' erosion gullies noted at left abutment contact. Appear to be formed from concentrated runoff on 4 levels of haul roads used during construction. Minor 1 or 2-inch deep erosion gullies noted on left abutment contact & downstream face.	Fill deep erosion gullies on left abutment contact with compacted ripped shale and regrade old haul roads to divert concentrated runoff away from the dam.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	No alignment conditions indicative of potential problems were observed.	Periodically check vertical & horizontal alignments.
RIPRAP FAILURES	Embankment slopes not provided with riprap.	None.

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
FOUNDATION	Foundation is underlain by Brallier shale but was not observed because of embankment and soil cover on abutments.	None.
ANY NOTICEABLE SEEPAGE	Seepage noted over about a 5' area at the toe of the right abutment and a boil was located about 15' downstream from the toe.	Monitor seepage and boil weekly. Check for enlargement, piping of material and check other downstream areas to insure other seeps or boils do not develop.
MATERIALS	Construction materials consist of clay core and shells are ripped shale from local borrow areas.	None.
DRAINS	There are no known drains.	None.
VEGETATION	Few small trees and patchy grass cover on downstream face. No vegetation observed on upstream face.	Remove scattered small trees before they grow bigger.

PRINCIPAL SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATION
CONTROL SECTIONS	The 5.5-foot square concrete drop-inlet appears in good condition. Flyash has dried to a consistency so that no water could be seen in the reservoir. Wooden supports in the drop-inlet appeared to be doing the job.	None.
APPROACH CHANNEL	NA	
DISCHARGE CHANNEL	Could not observe outlet pipe.	None.
BRIDGE AND PIERS	The wooden walkway supported by oil drums is stuck in the hardened flyash. The walkway is damaged slightly but still usable.	None.
EMERGENCY GATE	None.	
OTHER OUTLETS	A 14-inch decant pipe connected to a concrete drop-inlet near the left abutment appears to be in good condition. Flow from 2 new flyash lagoons above the dam is passing into the drop-inlet. The flow is then passing into the decant pipe and discharging into the Jackson River.	None.

EMERGENCY SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATION
CONTROL SECTION	A 30-foot wide open channel is cut in natural ground to the right of the right abutment. The side slopes are near vertical.	None.
APPROACH CHANNEL	The approach channel is very short and the slope is mild.	None.
DISCHARGE CHANNEL	The discharge channel is very steep with trees and shrubs growing on the slope. The flows would discharge into Dunlap Creek. A service road passes through the discharge channel before it drops to a steep slope.	None.
BRIDGE AND PIERS	NA	
MISCELLANEOUS	NA	

INSTRUMENTATION

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATION
MONUMENTATION/SURVEYS	No instrumentation provided to monitor embankment behavior.	Continue periodic visual inspections to observe if any unusual movement or cracking occurs.
OBSERVATION WELLS	None.	
WEIRS	None.	
PIEZOMETERS	None.	
STAFFGAGES	None.	
OTHER	None.	

RESERVOIR

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Reservoir rim slopes are naturally steep and for the most part weathered shale. Much of the slope areas are heavily vegetated. No distress was evident. The reservoir consumes most of the drainage area.	Periodically monitor for signs of instability.
SEDIMENTATION	Flyash has completely filled the design maximum storage volume. The flyash slopes down to the drop-inlets. The height of flyash varies by about 7 feet within the reservoir from 1423 msl near the drop-inlet to about 1430 along the rim.	None.

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
<p>CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)</p>	<p>There is no downstream channel. The area below the dam contains 2 C&O Railroad main tracks, then a short distance (about 50 feet) to Dunlap Creek.</p>	<p>None.</p>
<p>SLOPES</p>	<p>The slopes are steep and wooded.</p>	<p>None.</p>
<p>APPROXIMATE NO. OF HOMES AND POPULATION</p>	<p>No homes are located downstream of the dam. The railroad and a few industries are located a short distance along Dunlap Creek.</p>	<p>None.</p>

Check List
Engineering Data
Design, Construction, Operation

BORROW SOURCES	Construction Phase 3 clay from borrow pit near Covington Boys Home. Phase 4 clay from adjacent to dam and all ripped shale from borrow areas adjacent to dam.	None.
SPILLWAY PLAN SECTIONS DETAILS	Spillway is 30' wide dozer cut in rock. See Plate II of Appendix II.	None.
OPERATING EQUIPMENT PLANS & DETAILS	Drawings & details of the concrete drop-inlets and decant lines were furnished.	None.
MONITORING SYSTEMS	None are incorporated other than visual monitoring by Westvaco personnel.	
GEOLOGY REPORTS	None available.	
MATERIALS INVESTIGATIONS	None available except soil field density test for Phase III and IV construction.	Results of field testing appear questionable.
BORING RECORDS		
LABORATORY-FIELD TEST DATA		

APPENDIX IV

REFERENCES

1. Recommended Guidelines for Safety Inspection of Dams, Office of the Chief of Engineers, Department of the Army, Washington, D. C.
2. HEC-1DB Flood Hydrograph Package, (Hydrologic Engineering Center, U. S. Army Corps of Engineers, September 1978.)
3. "Probable Maximum Precipitation Estimates, United States East of the 105th Meridian," Hydrometeorological Report No. 51, (U. S. Weather Bureau, June 1978).
4. "Rainfall Frequency Atlas of the United States", Technical Paper No. 40, (U.S. Weather Bureau, May 1961).
5. Butts, Charles 1940, Geology of the Appalachian Valley in Virginia: Virginia Geological Survey, Bulletin 42, 568p.